Space Weather Technical Forecast

Issued on Monday, 28 August 2023 at 01:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of isolated M-flares (R1-R2 Blackouts). Glancing CME arrival possible Day 3 (30 Aug) with slight chance of G1/Minor Storms.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low, but with a declining trend in the early part of the 24 hours as X-ray flux recovered from a long period M-flare just prior to this period, from a source over the east limb. There are five sunspot regions on the visible disc, three of which are small and simple, however there are two sunspot groups of interest at this time. AR3415 in the southeast remains the most complex, with a persistent delta spot configuration, but has been largely inactive. The larger AR3413 near centre disk has seen its beta-gamma configuration fade, but retains a north-south magnetic alignment which could have some instability. A region over the east limb (not yet visible) gave the long period M-flare mentioned above, so this area is one to watch in the coming days.
No new Earth directed CMEs have been seen in available imagery over the last 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by ACE at L1, were at mostly background levels. Wind speeds slowly eased from near 400 km/s to around 350 km/s. Density was mostly below average. The interplanetary magnetic field, Bt, was weak throughout, below 7nT. The north-south component, Bz, has been mainly negative (southward directed), varying weakly between +3/-6 nT. Phi angle was predominantly positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux remained at background levels. GOES16 high energy (greater than 2MeV) electron flux was mostly at background levels. The associated 24-hour fluence was well below Active on a fairly steady trend, with 3.87e6 integrated pfu observed at 28/0000 UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar Activity is expected to be generally Low, but with a chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: A CME may give a glancing impact at Earth sometime on Day 3 (30 Aug), though this is low confidence. There are no other Earth-directed CMEs currently forecast. Wind speeds are currently at background levels, but with a possible High Speed Stream (HSS) arrival from CH38/- during Day 1 (28 Aug). Wind speeds may reach slightly elevated levels of 400-450 km/s, although confidence is low. Should this HSS occur, wind speeds are then expected to slowly ease into Days 2 and 3 (29-30 Aug). In the absence of any HSS, background wind speeds are expected to persist until the potential CME arrival mentioned above.
Geomagnetic activity is expected to remain generally Quiet to Unsettled, with a chance of Active intervals on Day 1 in association with the possible HSS. If the CME glance occurs on Day 3, activity may become Unsettled to Active with a slight chance of G1/Minor Storm intervals, with effects easing into Day 4 (31 Aug).

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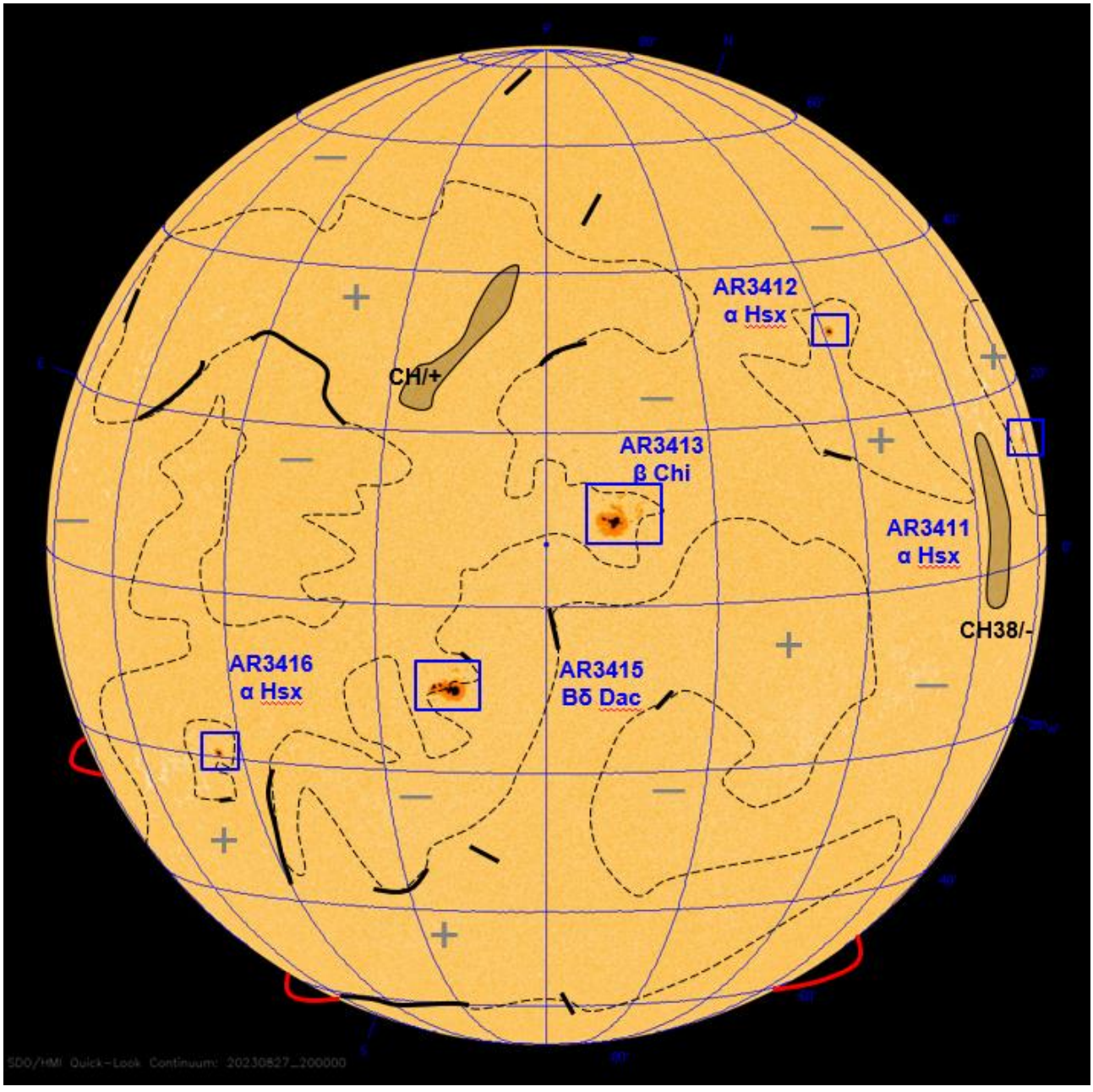
Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to remain at background levels, with just a slight chance of enhancement should any larger flares occur from AR3413 or AR3415. High energy (greater than 2 MeV) electron flux is expected to persist at mainly background levels, perhaps reaching moderate at the diurnal maxima. The associated 24 hour fluence is expected to remain below the Active level (1e8 integrated pfu).

Figure 1. Solar Analysis Valid 27/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The C2.2 flare and associated dimming from AR3413 at 25/1006 UTC likely produced a CME, with a very faint eruption subsequently detected in SOHO imagery. Assessment of this suggests a glancing CME impact is possible at Earth sometime on Day 3 (30 Aug) though this is low confidence. There are no other Earth-directed CMEs currently forecast.

Wind speeds are currently at background levels, but with a possible High Speed Stream (HSS) arrival from CH38/- during Day 1 (28 Aug). Wind speeds may reach slightly elevated levels of 400-450 km/s, although confidence is low as this feature is now later than originally expected. As such, wind speeds are likely to be slower than earlier thoughts and any impacts also reduced. In addition, negative polarity coronal holes are not favoured for a strong connection at this time of year. Should this HSS occur, wind speeds are then expected to slowly ease into Days 2 and 3 (29-30 Aug). In the absence of any HSS, background wind speeds are expected to persist until the potential CME arrival mentioned above.

Geomagnetic activity is expected to remain generally Quiet to Unsettled, with a chance of Active intervals on Day 1 in association with the possible HSS. If the CME glance occurs on Day 3, activity may become Unsettled to Active with a slight chance of G1/Minor Storm intervals, with effects easing into Day 4 (31 Aug).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	15	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
26/1733	Partial	C2.2 flare	NW-centre disc	529 km/s	30/1200 UTC +/- 10 hours	Low confidence. Directed SE, despite NW location.

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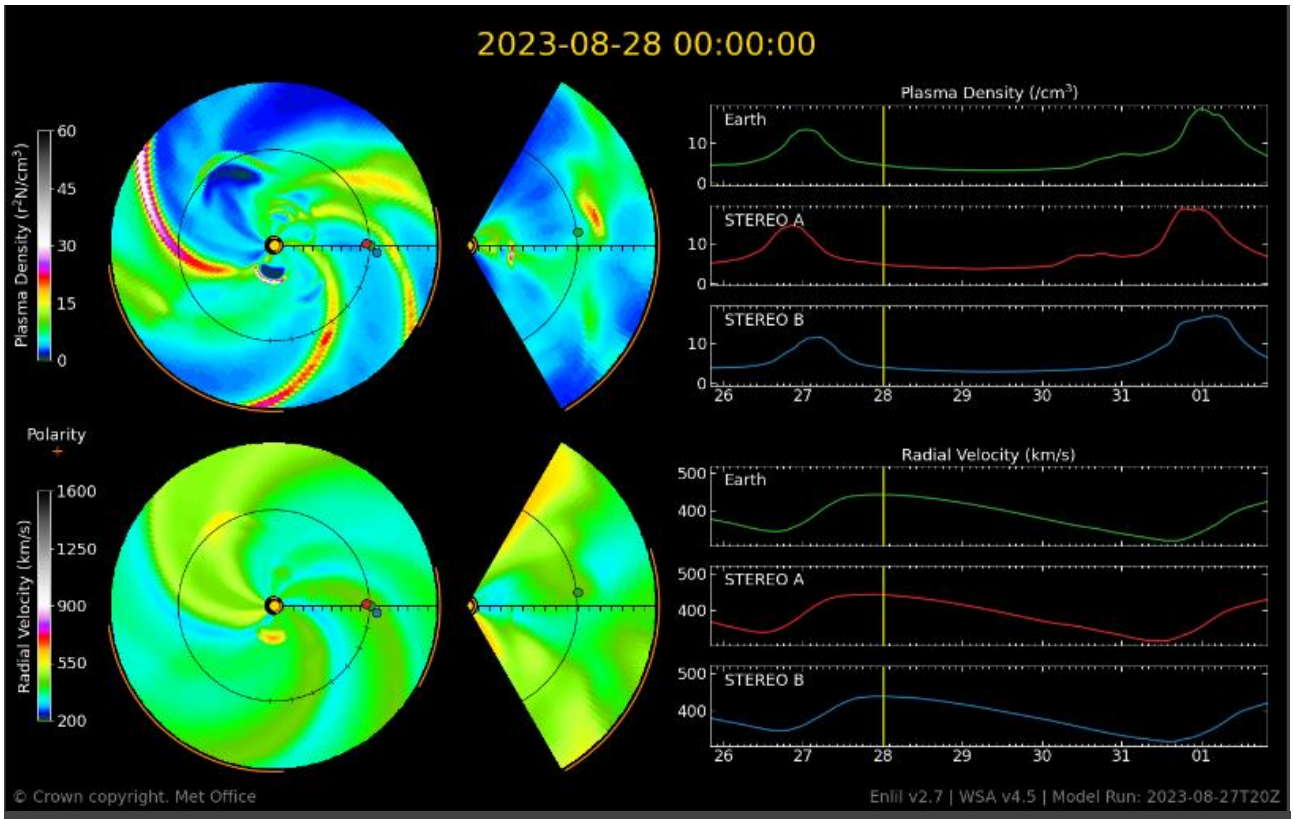
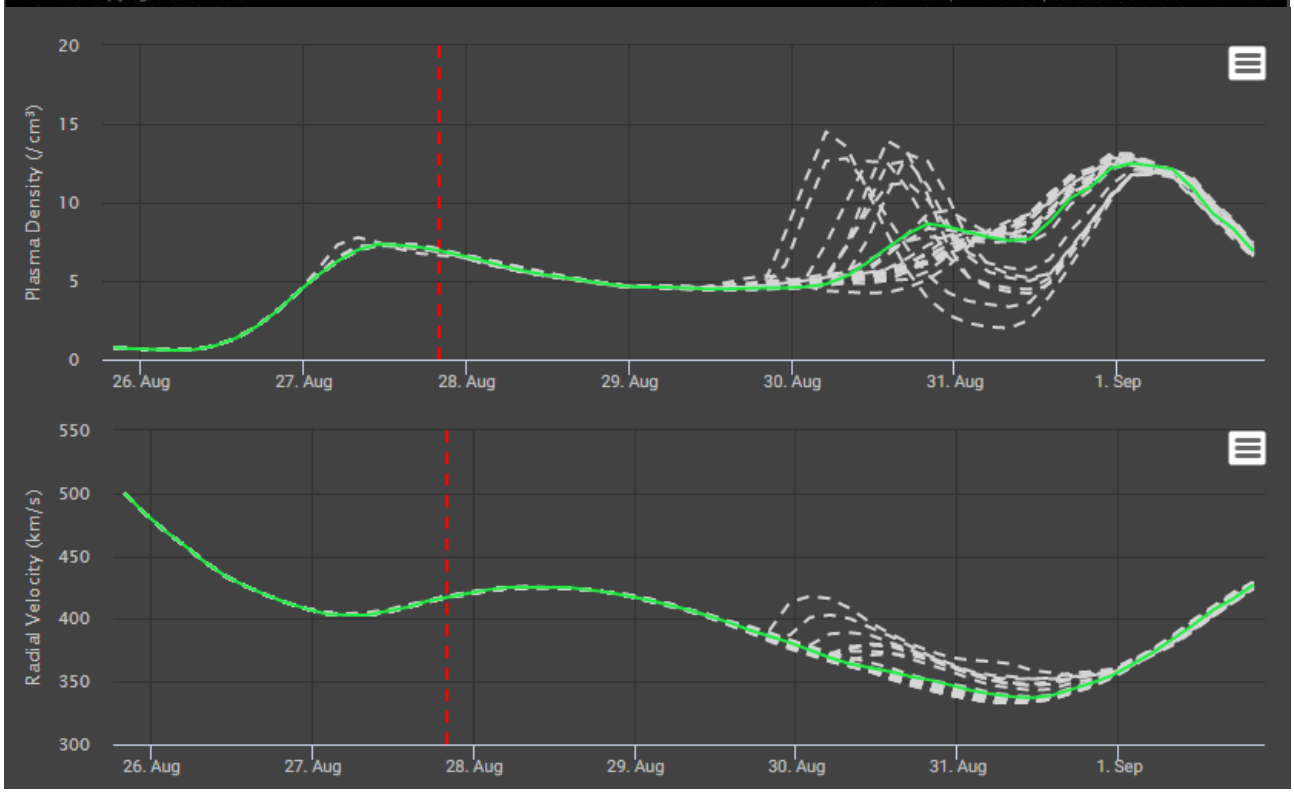
Figure 2: MOSWOC Enlil and ensemble, showing a possible CME glancing blow on 30 August. However, Enlil is forecasting that Earth is already in the expected HSS, which may arrive in the next few hours, although likely weaker than originally thought.





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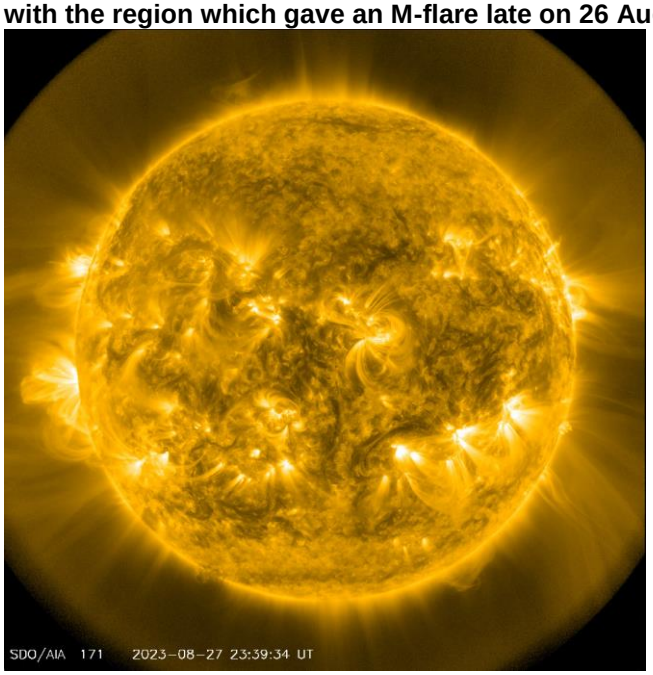
Radio Blackouts - X-Ray Flares:
Solar activity has been Low, but with a declining trend in the early part of the last 24 hours as X-ray flux recovered from a long period M-flare just prior to this period, from an uncertain source over the east limb. Generally Low activity is expected during the forecast period, but there there is a chance of further isolated M-flares, either from AR3413/AR3415 or perhaps more likely from the region currently just over the east limb, with a very slight chance of an isolated X-flare.

There are five sunspot regions on the visible disc. Three of these are small and simple with no change, however there are two sunspot groups of interest at this time. AR3415 (Dac/Beta-Delta) in the southeast remains the most complex, with a persistent delta spot configuration, but has remained largely inactive. The larger AR3413 (Chi/Beta) near centre disk has seen its beta-gamma configuration fade, but retains a north-south magnetic alignment which could have some instability. A region over the east limb (not yet visible) gave the long period M-flare mentioned above, so this area is one to watch. This region could increase activity once it rotates onto the eastern disc, however the timing of this is currently uncertain, and the region cannot be assessed until it becomes visible. Therefore a slight increase in flare probability has been highlighted for now from Day 2 (29 Aug) onwards.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	25	35	35	35
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: SDO AIA-171 imagery, showing increased magnetic looping over the east limb, associated with the region which gave an M-flare late on 26 August.



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Solar Radiation Storms - (High Energy Protons):
High energy (greater than 10MeV) proton flux observed by GOES16 is expected to remain at background levels with just a slight chance of enhancement. The main risk of any increased proton flux would be from the occurrence of any larger flares from AR3415 or AR3413, with these near centre disc and starting to transit through the western hemisphere.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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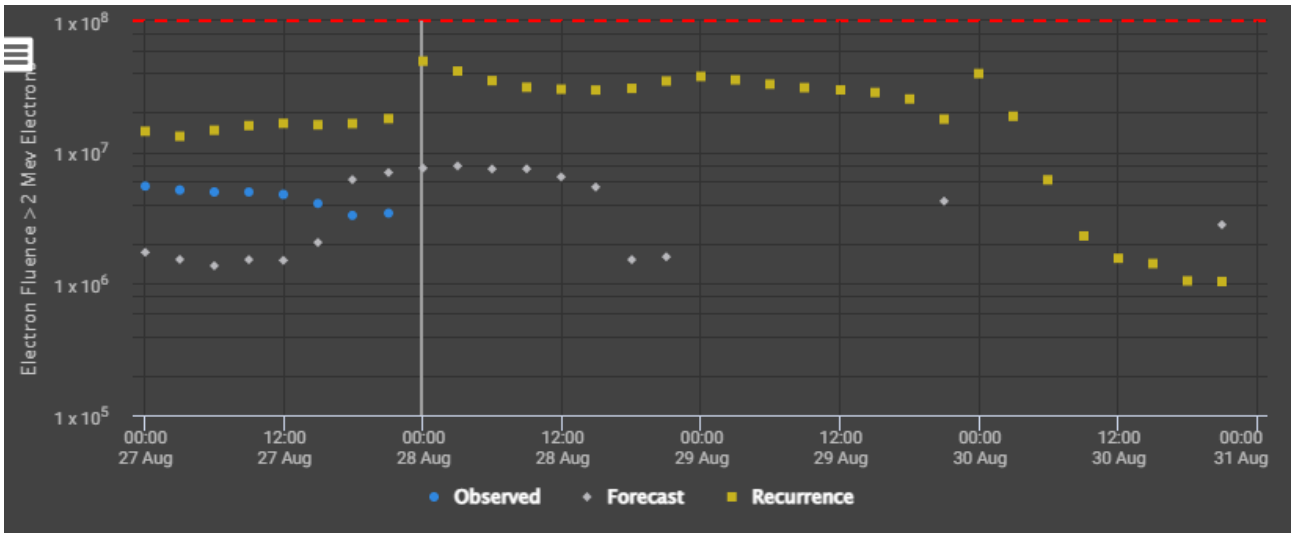
High Energy Electrons Event (≥ 2MeV):
High energy (greater than 2 MeV) electron flux observed by GOES16 persisted at mainly background levels, with a very subdued response to the recent HSS. A possible further HSS arrival during Day 1 (28 Aug) may bring a slight risk of enhancement into this period. However, given that this feature is now late and therefore likely weaker, along with a probable very limited geomagnetic response, any increase to the observed flux is expected to be limited. If there is a response, flux is expected to peak at moderate levels. In addition, a possible CME glancing blow on Day 3 (30 Aug) could also keep flux levels suppressed.

The associated 24 hour fluence is expected to remain below the Active (1e8 integrated pfu) level, with any rise in fluence likely to be modest. This is supported by REFM, which currently seems to be a reasonable guide.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	5	5	5
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: MOSWOC REFM showing a fairly steady below Active trend, which looks reasonable.



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